Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3171003 Date:12-05-2025

Subject Name:Digital Signal Processing

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	List advantages of digital signal processing.	**03**
	(b)	Explain any one linear and time invariant discrete time system with example.	**04**
	(c)	Derive necessary conditions for a discrete LTI system to be causal and BIBO stable.	**07**
Q.2	**(a)**	Explain correlation of the discrete time signals with example.	**03**
	(b)	Compute DTFT of $x(n)=\{1,2,1,2\}$ ↑	**04**
	(c)	Find output $y(n)$ of system whose impulse response $h(n)=\{-1, 2, 0, 1\}$ and input sequence $x(n)=a^n u(n)$ for $0 \le n \le 3$. Take $a = 0.5$. ↑	**07**
		OR	
	(c)	Explain all pass system with necessary example and its applications.	**07**
Q.3	**(a)**	Prove differentiation in Z-domain property of Z-transform.	**03**
	(b)	Prove time shifting property of D.T.F.T.	**04**
	(c)	What is linear phase filter? Explain its types with examples. Give its applications.	**07**
		OR	
Q.3	**(a)**	Prove associative property of linear convolution.	**03**
	(b)	List properties of ROC in context of Z-transform for finite and infinite duration sequences only.	**04**
	(c)	Let $y(n)-0.75y(n-1)+0.125y(n-2)=x(n)+0.5x(n-1)$ is the difference equation of a filter. Draw direct form-I and direct form-II structures for this filter. Comment on both the structures for its hardware needs.	**07**
Q.4	**(a)**	Obtain difference equation and impulse response for system whose transfer function is given by $H(z)=\frac{z}{z-0.2}$ With ROC $\|z\| < 0.2$.	**03**
	(b)	Find Z-transform along with its ROC for the sequence given by $x(n)=\left(\frac{1}{2}\right)^n u(n)-\left(\frac{3}{4}\right)^n u(-n-1)$. Show its pole and zero.	**04**
	(c)	Obtain sequence $x(n)$ from its Z-transform $X(z)$ as given below for $\|z\| > 0.6$ and $0.2 < \|z\| < 0.6$ cases of ROC. $X(z)=\frac{1}{1-0.8z^{-1}+0.12z^{-1}}$	**07**
		OR	
Q.4	**(a)**	A system transfer function is given by	**03**

$$H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - 0.75z^{-1} + 0.125z^{-2}}$$

Draw direct form –I implementation for this system.

(b) What is minimum phase system? Explain it with example. **04**

(c) Draw and explain radix-2 decimation in time algorithm for calculating DFT. **07**

Q.5 **(a)** Compute 4 point DFT for the sequence $x(n) = \cos(n\pi/2)u(n)$ for $n \leq 3$. **03**

(b) Compute circular convolution of the sequences $x_1(n)=\{1,2,1,2\}$ and $x_2(n)=\{1,2,3,4\}$. Consider $n=0$ for first samples in both sequences. **04**

(c) Design an FIR low pass filter with passband gain of *0dB*, cutoff frequency of *200 Hz*. Take sampling frequency as *1 KHz*, Window as rectangular and length of impulse response as 7. **07**

OR

Q.5 **(a)** Compare IIR and FIR filters. **03**

(b) Convert following analog filter as given by *H(s)* into digital filter *H(z)* using impulse invariance method. Take sampling frequency as 1Hz. **04**

$$H(s) = \frac{0.5}{s^2 + 3s + 2}$$

(c) For the sequences *x(n)={0,1,2,3}* ,find 4-point DFT *X(k)*. Also take 4-point IDFT of *X(k)* obtained earlier to get *x(n)*. Compare result. **07**

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